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1 [A case for fractured mirrors](#)

Ravishankar Ramamurthy, David J. DeWitt, Qi Su

August 2003 **The VLDB Journal — The International Journal on Very Large Data Bases**,

Volume 12 Issue 2

Full text available: [pdf\(200.49 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Abstract. The decomposition storage model (DSM) vertically partitions all attributes of a table and has excellent I/O behavior when the number of attributes accessed by a query is small. It also has a better cache footprint than the standard storage model (NSM) used by most database systems. However, DSM incurs a high cost in reconstructing the original tuple from its partitions. We first revisit some of the performance problems associated with DSM and suggest a simple indexing strategy and compa ...

Keywords: Data placement, Disk mirroring, Vertical partitioning

2 [Run-time modeling and estimation of operating system power consumption](#)

Tao Li, Lizy Kurian John

June 2003 **ACM SIGMETRICS Performance Evaluation Review , Proceedings of the 2003 ACM SIGMETRICS international conference on Measurement and modeling of computer systems**, Volume 31 Issue 1Full text available: [pdf\(233.33 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The increasing constraints on power consumption in many computing systems point to the need for power modeling and estimation for all components of a system. The Operating System (OS) constitutes a major software component and dissipates a significant portion of total power in many modern application executions. Therefore, modeling OS power is imperative for accurate software power evaluation, as well as power management (e.g. dynamic thermal control and equal energy scheduling) in the light of ...

Keywords: low power, operating system, power estimation

3 [E-services: The Web services debate: .NET vs. J2EE](#)

Gerry Miller

June 2003 **Communications of the ACM**, Volume 46 Issue 6Full text available: [pdf\(141.83 KB\)](#) [html\(18.03 KB\)](#)Additional Information: [full citation](#), [index terms](#)


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1 [A modeling study of the TPC-C benchmark](#)

Scott T. Leutenegger, Daniel Dias

 June 1993 **ACM SIGMOD Record , Proceedings of the 1993 ACM SIGMOD international conference on Management of data**, Volume 22 Issue 2

 Full text available: [pdf\(1.13 MB\)](#)

 Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The TPC-C benchmark is a new benchmark approved by the TPC council intended for comparing database platforms running a medium complexity transaction processing workload. Some key aspects in which this new benchmark differs from the TPC-A benchmark are in having several transaction types, some of which are more complex than that in TPC-A, and in having data access skew. In this paper we present results from a modelling study of the TPC-C benchmark for both single node and distributed databas ...

2 [Dynamic page placement to improve locality in CC-NUMA multiprocessors for TPC-C](#)

Kenneth M. Wilson, Bob B. Aglietti

 November 2001 **Proceedings of the 2001 ACM/IEEE conference on Supercomputing (CDROM)**

 Full text available: [pdf\(828.19 KB\)](#)

 Additional Information: [full citation](#), [abstract](#), [references](#)

The use of CC-NUMA multiprocessors complicates the placement of physical memory pages. Memory closest to a processor provides the best access time, but optimal memory page placement is a difficult problem with process movement, multiple processes requiring access to the same physical memory page, and application behavior changing over execution time. We use dynamic page placement to move memory pages where needed for the database benchmark TPC-C executing on a four node CC-NUMA multiprocessor. D ...

Keywords: CC-NUMA, TPC-C, dynamic page placement, migration, multiprocessor, replication

3 [Order-of-magnitude advantage on TPC-C through massive parallelism](#)

Charles Levine

 May 1995 **ACM SIGMOD Record , Proceedings of the 1995 ACM SIGMOD international conference on Management of data**, Volume 24 Issue 2

 Full text available: [pdf\(169.02 KB\)](#)

 Additional Information: [full citation](#), [abstract](#), [index terms](#)


TPC Benchmark™ C (TPC-C) is the modern standard for measuring OLTP performance. Running TPC-C, Tandem demonstrated a massively parallel configuration of 112 CPUs which

achieved ten times higher performance than any other system previously measured (and today is still better by a factor of five). This result qualifies as the largest industry-standard benchmark ever run. This paper briefly describes how the benchmark was configured and the results which were obtained.

4 I/O reference behavior of production database workloads and the TPC benchmarks— an analysis at the logical level

Windsor W. Hsu, Alan Jay Smith, Honesty C. Young

March 2001 **ACM Transactions on Database Systems (TODS)**, Volume 26 Issue 1

Full text available:  [pdf\(5.42 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)


As improvements in processor performance continue to far outpace improvements in storage performance, I/O is increasingly the bottleneck in computer systems, especially in large database systems that manage huge amounts of data. The key to achieving good I/O performance is to thoroughly understand its characteristics. In this article we present a comprehensive analysis of the logical I/O reference behavior of the peak production database workloads from ten of the world's largest corporatio ...

Keywords: I/O, TPC benchmarks, caching, locality, prefetching, production database workloads, reference behavior, sequentiality, workload characterization

5 Goal-oriented buffer management revisited

Kurt P. Brown, Michael J. Carey, Miron Livny

June 1996 **ACM SIGMOD Record , Proceedings of the 1996 ACM SIGMOD international conference on Management of data**, Volume 25 Issue 2

Full text available:  [pdf\(1.56 MB\)](#)


Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

In this paper we revisit the problem of achieving multi-class workload response time goals by automatically adjusting the buffer memory allocations of each workload class. We discuss the virtues and limitations of previous work with respect to a set of criteria we lay out for judging the success of any goal-oriented resource allocation algorithm. We then introduce the concept of *hit rate concavity* and develop a new goal-oriented buffer allocation algorithm, called *Class Fencing*, th ...

6 Database buffer size investigation for OLTP workloads

Thin-Fong Tsuei, Allan N. Packer, Keng-Tai Ko

June 1997 **ACM SIGMOD Record , Proceedings of the 1997 ACM SIGMOD international conference on Management of data**, Volume 26 Issue 2

Full text available:  [pdf\(1.35 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

It is generally accepted that On-Line Transaction Processing (OLTP) systems benefit from large database memory buffers. As enterprise database systems become larger and more complex, hardware vendors are building increasingly large systems capable of supporting huge memory configurations. Database vendors in turn are developing buffer schemes to exploit this physical memory. How much will these developments benefit OLTP workloads? Through empirical studies on databases sized comp ...

7 Improving cache performance with balanced tag and data paths

Jih-Kwon Peir, Windsor W. Hsu, Honesty Young, Shauchi Ong

September 1996 **Proceedings of the seventh international conference on Architectural support for programming languages and operating systems**, Volume 31 , 30 Issue 9 , 5

Full text available:  [pdf\(1.07 MB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

There are two concurrent paths in a typical cache access --- one through the data array and the other through the tag array. The path through the data array drives the selected set out of the array. The path through the tag array determines cache hit/miss and, for set-associative caches, selects the appropriate line from within the selected set. In both direct-mapped and set-associative caches, the path through the tag array is significantly longer than that through the data array. In this paper ...

8 Performance characterization of a Quad Pentium Pro SMP using OLTP workloads ☐



Kimberly Keeton, David A. Patterson, Yong Qiang He, Roger C. Raphael, Walter E. Baker
April 1998 **ACM SIGARCH Computer Architecture News , Proceedings of the 25th annual international symposium on Computer architecture**, Volume 26 Issue 3

Full text available:  [pdf\(1.58 MB\)](#)  Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)
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Commercial applications are an important, yet often overlooked, workload with significantly different characteristics from technical workloads. The potential impact of these differences is that computers optimized for technical workloads may not provide good performance for commercial applications, and these applications may not fully exploit advances in processor design. To evaluate these issues, we use hardware counters to measure architectural features of a four-processor Pentium Pro-based se ...

9 Capturing dynamic memory reference behavior with adaptive cache topology ☐

Jih-Kwon Peir, Yongjoon Lee, Windsor W. Hsu
October 1998 **Proceedings of the eighth international conference on Architectural support for programming languages and operating systems**, Volume 33 , 32 Issue 11 , 5

Full text available:  [pdf\(1.50 MB\)](#)  Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Memory references exhibit locality and are therefore not uniformly distributed across the sets of a cache. This skew reduces the effectiveness of a cache because it results in the caching of a considerable number of less-recently-used lines which are less likely to be re-referenced before they are replaced. In this paper, we describe a technique that dynamically identifies these less-recently-used lines and effectively utilizes the cache frames they occupy to more accurately approximate the glob ...

10 Experiences with VI communication for database storage ☐

Yuanyuan Zhou, Angelos Bilas, Suresh Jagannathan, Cezary Dubnicki, James F. Philbin, Kai Li
May 2002 **ACM SIGARCH Computer Architecture News**, Volume 30 Issue 2

Full text available:  [pdf\(1.29 MB\)](#)  Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)
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This paper examines how VI-based interconnects can be used to improve I/O path performance between a database server and the storage subsystem. We design and implement a software layer, DSA, that is layered between the application and VI. DSA takes advantage of specific VI features and deals with many of its shortcomings. We provide and evaluate one kernel-level and two user-level implementations of DSA. These implementations trade transparency and generality for performance at different degrees ...

Keywords: Storage system, cluster-based storage, Database storage, storage area network, User-level Communication, Virtual Interface Architecture, processor overhead

11 A permutation-based page interleaving scheme to reduce row-buffer conflicts and exploit data locality ☐

Zhao Zhang, Zhichun Zhu, Xiaodong Zhang

December 2000 **Proceedings of the 33rd annual ACM/IEEE international symposium on Microarchitecture**

Full text available:  [pdf\(153.06 KB\)](#)
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Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

12 [A methodology for auto-recognizing DBMS workloads](#) ☐

Said S. Elnaffar

September 2002 **Proceedings of the 2002 conference of the Centre for Advanced Studies on Collaborative research**

Full text available:  [pdf\(332.94 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The type of the workload on a database management system (DBMS) is a key consideration in tuning the system. Allocations for resources such as main memory can be very different depending on whether the workload type is Online Transaction Processing (OLTP) or Decision Support System (DSS). A DBMS also typically experiences changes in the type of workload it handles during its normal processing cycle. Database administrators must, therefore, recognize the significant shifts of workload type that d ...

13 [Backtrack programming in welded girder design](#) ☐

Albert D. M. Lewis

July 1968 **Proceedings of the fifth annual 1968 design automation workshop on Design automation**

Full text available:  [pdf\(527.84 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The object of engineering design is to satisfy some need of man with the maximization or minimization of some measure of effectiveness of the solution. Common measures of effectiveness are cost, cost-benefit ratio, and profit. In mathematical terminology an object or facility can be described by a list or vector of parameter values. The position of each element in the vector associates it with a particular parameter. The performance of the object or facility and the constraints imposed on t ...

14 [Modeling methodology: Facilitating level three cache studies using set sampling](#) ☐

Niki C. Thornock, J. Kelly Flanagan

December 2000 **Proceedings of the 32nd conference on Winter simulation**

Full text available:  [pdf\(103.33 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [references](#)

We discuss some of the difficulties present in trace collection and trace-driven cache simulation. We then describe our multiprocessor tracing technique and verify that it accurately collects long traces. We propose sampling as a method to reduce required disk space, enable simulations to run faster, and effectively enlarge the trace buffer of our hardware monitor, decreasing trace distortion. To this end, we investigate time sampling and two types of set sampling. We conclude that the second se ...

15 [New TPC benchmarks for decision support and web commerce](#) ☐

Meikel Poess, Chris Floyd

December 2000 **ACM SIGMOD Record**, Volume 29 Issue 4

Full text available:  [pdf\(686.16 KB\)](#)

Additional Information: [full citation](#), [abstract](#), [citations](#), [index terms](#)

For as long as there have been DBMS's and applications that use them, there has been interest in the performance characteristics that these systems exhibit. This month's column describes some of the recent work that has taken place in TPC, the Transaction Processing Performance Council. TPC-A and TPC-B are obsolete benchmarks that you might have heard about in the past. TPC-C V3.5 is the current benchmark for OLTP systems. Introduced in 1992, it has been run on many hardware platforms and DBMS's. ...

16 Configuring buffer pools in DB2 UDB ☐


Xiaoyi Xu, Patrick Martin, Wendy Powley

September 2002 **Proceedings of the 2002 conference of the Centre for Advanced Studies on Collaborative research**Full text available:  pdf(96.74 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Database Management Systems (DBMSs) use a main memory area as a buffer to reduce the number of disk accesses performed by a transaction. DB2 Universal Database divides the buffer area into a number of independent buffer pools and each database object (table or index) is assigned to a specific buffer pool. The tasks of configuring the buffer pools, which defines the mapping of database objects to buffer pools and setting a size for each of the buffer pools, is crucial for achieving optimal perfor ...

17 Contrasting characteristics and cache performance of technical and multi-user commercial workloads ☐

Ann Marie Grizzaffi Maynard, Colette M. Donnelly, Bret R. Olszewski

November 1994 **Proceedings of the sixth international conference on Architectural support for programming languages and operating systems**, Volume 29 , 28 Issue 11 , 5Full text available:  pdf(1.35 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Experience has shown that many widely used benchmarks are poor predictors of the performance of systems running commercial applications. Research into this anomaly has long been hampered by a lack of address traces from representative multi-user commercial workloads. This paper presents research, using traces of industry-standard commercial benchmarks, which examines the characteristic differences between technical and commercial workloads and illustrates how those differences affect cache ...

Keywords: cache performance, commercial workloads, memory subsystems, operating system activity, technical applications

18 Performance modeling study of a client/server system architecture ☐

Ji Shen, Shahla Butler

December 1994 **Proceedings of the 26th conference on Winter simulation**Full text available:  pdf(639.14 KB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)**19** An analytical model for buffer hit rate prediction ☐

Yongli Xi, Patrick Martin, Wendy Powley

November 2001 **Proceedings of the 2001 conference of the Centre for Advanced Studies on Collaborative research**Full text available:  pdf(100.79 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Of the many tuning parameters available in a database management system (DBMS), one of the most crucial to performance is the buffer pool size. Choosing an appropriate size, however, can be a difficult task. In this paper we present an analytical modeling approach to predicting the buffer pool hit rate that can be used to simplify the process of buffer pool sizing. A Markov Chain model is used to estimate the hit rate for buffer pools in IBM's DB2 Universal Database. We present and experimental ...

20 ☐Energy aware design: Optimizing pipelines for power and performance

Viji Srinivasan, David Brooks, Michael Gschwind, Pradip Bose, Victor Zyuban, Philip N.

Strenski, Philip G. Emma

November 2002 **Proceedings of the 35th annual ACM/IEEE international symposium on Microarchitecture**

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During the concept phase and definition of next generation high-end processors, power and performance will need to be weighted appropriately to deliver competitive cost/performance. It is not enough to adopt a CPI-centric view alone in early-stage definition studies. One of the fundamental issues confronting the architect at this stage is the choice of pipeline depth and target frequency. In this paper we present an optimization methodology that starts with an analytical power-performance model ...

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A modeling study of the TPC-C benchmark

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↑ ABSTRACT

The TPC-C benchmark is a new benchmark approved by the TPC council intended for comparing database platforms running a medium complexity transaction processing workload. Some key aspects in which this new benchmark differs from the TPC-A benchmark are in having several transaction types, some of which are more complex than that in TPC-A, and in having data access skew. In this paper we present results from a modelling study of the TPC-C benchmark for both single node and distributed database management systems. We simulate the TPC-C workload to determine expected buffer miss rates assuming an LRU buffer management policy. These miss rates are then used as inputs to a throughput model. From these models we show the following: (i) We quantify the data access skew as specified in the benchmark and show what fraction of the accesses go to what fraction of the data. (ii) We quantify the resulting buffer hit ratios for each relation as a function of buffer size. (iii) We show that close to linear scale-up (about 3% from the ideal) can be achieved in a distributed system, assuming replication of a read-only table. (iv) We examine the effect of packing hot tuples into pages and show that significant price/performance benefit can be thus achieved. (v) Finally, by coupling the buffer simulations with the throughput model, we examine typical disk/memory configurations that maximize the overall price/performance.

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